The Effects of a Supervised Resistance-Training Program on Special Olympics Athletes

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Objective: To examine the effects of a resistance-training program on athletes with intellectual disabilities (ID). Design/Participants: 2-way (2 × 2), repeated-measures analysis of variance on 2 groups (males and females); 30 Special Olympics (SO) athletes, age 16–22 (16 males, 14 females). Intervention/Outcome Measures: Resistance training, twice per week, for 3 months on Med-X weight equipment. Exercises tested: chest press, abdominal crunch, seated row, overhead press, seated dip, lower back extension, and biceps curl. The weight lifted and the number of repetitions performed were used to determine predicted 1-repetition max (1RM). Results: All participants as a group increased significantly in predicted 1RM for each exercise performed. Males were stronger than females for 5 of the 7 exercises. A significant interaction effect between genders was demonstrated for the seated dip. Conclusion: Significant strength gains can be accomplished by adolescents with ID via a supervised resistance-training program. Keywords: special populations, intellectual disabilities, weight training

Adolescent physical fitness is a major health concern for the general population. Multiple studies describing the general adult population have demonstrated that resistance-training programs can improve muscle strength and endurance, aerobic and physical work capacity, body composition, and metabolic function. Few studies, however, have demonstrated the benefits of physical fitness and strength training for adolescents with intellectual disabilities (ID), yet this is the age group that frequently participates in weight-training events such as Lift America and Special Olympics (SO) competitions. With over 2.2 million SO athletes worldwide and increasing, more research needs to be done in this unique athlete population to determine overall fitness levels and resistance-training outcomes. An SO athlete is defined as a person more than 8 years of age with an ID diagnosed by a professional organization.

As with anyone, a healthy physical fitness status is crucial to those with ID to perform athletic endeavors and endure the rigors of vocational responsibilities and pursuits. Proper fitness also helps prevent illnesses associated with seden-
tary lifestyles (eg, obesity, diabetes, hypertension, cardiovascular disease).\textsuperscript{12–17} People with ID can participate in supervised fitness programs and significantly improve their cardiac functional capacity, muscle endurance, flexibility, and overall level of physical fitness, as well as self-efficacy.\textsuperscript{7,18–25} There is a shortage of published studies, however, focusing on resistance training for persons with ID, especially adolescents and young adults. Thus, the purpose of this study was to examine the effects of a supervised resistance-training program on SO athletes age 16–22 with ID, in relation to the athletes’ gender. The hypothesis was that the weights lifted would increase from pretesting to posttesting and the improvements would be similar for the males and females, indicating a gain in strength.

\section*{Methods}

\section*{Participants}

The participants in this study were 30 SO athletes (16 males, 14 females; age 16–22, mean age 19) from a physical education class at the Sidney Lanier Center in Florida. Mean height for the group was 67.2 in, or 170.7 cm (males were 70.1 in, or 178 cm; females were 63.9 in, or 162.4 cm). Mean weight for the group was 185.3 lb, or 84.2 kg (males were 205.1 lb, or 93.2 kg; females were 162.6 lb, or 73.9 kg). The mean body-mass index for the group was 29.9 (31.2 for the males and 28.7 for the females). The students had varying degrees of ID, ranging from very mild to severe. Participation in the study was based on teacher recommendation, physician approval, parent or guardian consent, and their own desire to participate. Program participation was incorporated into their school day as their physical education course. Each student, with his or her parent or guardian, completed an SO medical release form, as well as an informed-consent form approved by the university institutional review board. Sidney Lanier Center instructors, University of Florida staff, and student volunteers supervised participation.

\section*{Program}

The SO athletes voluntarily participated in a program of resistance training twice a week for 3 months, for a total of 22–24 sessions. Each training session was approximately 50 minutes in length. The first 5 minutes included an aerobic warm-up activity (jogging or walking) followed by some brief stretching of the upper and lower extremities.\textsuperscript{26–28} Participants spent the next 25 minutes strength training in a fitness facility using Med-X equipment (Med-X, Ocala, FL) lifting weights for 1 set of 8–12 repetitions. When the participant could accomplish 12 repetitions, the next session’s weight was increased by approximately 1 plate on the machine as long as at least 8 repetitions could be achieved. The SO athletes spent the last 10–20 minutes of the program participating in group games and sport-skill-learning activities that promoted inclusion and socialization with their university volunteer partners (SO coaches). This last segment of the program was important because it coupled physical activity and social integration. Each activity was modified to incorporate all the students to achieve maximal participation.\textsuperscript{29,30}
Data Collection

All data were collected using equipment at a University of Florida wellness center, Living Well. Pretest values were assessed by having program participants use each machine at the beginning of the study and recording the weight lifted (in pounds), the repetitions, and the appropriate setting for each individual for each weight machine (eg, seat height). The “predicted 1-repetition maximum” (1RM) was calculated by the weight lifted and the number of repetitions performed. Based on a participant’s predicted 1RM, the training program was prescribed for the appropriate weight to be lifted 8–12 times.

Tests were administered by university volunteers who were instructed on correct testing and training protocols to administer the training to the SO athletes throughout the program. Volunteers were supervised by the principal investigator (with CSCS, ATC, and LAT credentials), the Living Well director (with appropriate ACSM credentials) and her staff, and graduate students in adapted physical activity and human-performance fields. Specific testing included strength analysis and recordings of the weight lifted on the fitness center’s Med-X equipment. The machines used in this study were the chest press, abdominal crunch, seated row, overhead press, seated dip, lower back extension, and biceps curl.

Only upper extremity exercises were used during this program because of the need for maintenance and repair on some of the lower extremity machines and the desire to focus more closely on fewer muscle groups for this study. In addition, it became apparent that it might be helpful to focus on the upper extremity because many of the participants’ vocational tasks put demands on this musculature (for stocking shelves at warehouse stores, folding and carrying laundry, and bagging and carrying grocery bags at supermarkets). Nonetheless, a follow-up study focusing on the lower extremity muscle groups is planned.

In summary, the weight lifted and the number of repetitions performed determined predicted 1RM for both pretest and posttest status. These predicted 1RM scores were used for all the statistical analyses. After implementation, fitness status was retested (posttesting) using the same procedure as the pretest to see how or if participants’ fitness levels had changed.

Data Analysis

The data from each exercise were analyzed using separate 2-way (2 × 2) repeated-measures analyses of variance (ANOVAs). These tests were performed to determine any differences between pretest and posttest scores and between males and females. The traditional level of significance (alpha = .05) was used.

Results

From pretesting to posttesting, participants increased significantly in predicted 1RM for each of the 7 exercises performed. Thus, their average strength (males and females combined) increased significantly with training (chest press $F_{1,28} = 85.028, P < .001$; abdominal crunch $F_{1,28} = 62.942, P < .001$; seated row $F_{1,28} = 56.592, P < .001$; overhead press $F_{1,28} = 79.245$; biceps curl $F_{1,28} = 27.998, P < .001$; seated dip $F_{1,28} = 81.631, P < .001$; lower back $F_{1,28} = 53.328, P < .001$). See Table 1 and Figure 1.
Table 1 Pretest-to-Posttest Means, SDs, and Ranges for All Participants (N = 30)

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Test</th>
<th>Mean</th>
<th>SD</th>
<th>Range span</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest press</td>
<td>pretest</td>
<td>114.29</td>
<td>69.44</td>
<td>212.8</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>167.93</td>
<td>69.98</td>
<td>159.6</td>
</tr>
<tr>
<td>Abdominal crunch</td>
<td>pretest</td>
<td>84.23</td>
<td>37.67</td>
<td>133.0</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>122.09</td>
<td>39.90</td>
<td>132.2</td>
</tr>
<tr>
<td>Seated row</td>
<td>pretest</td>
<td>141.91</td>
<td>74.00</td>
<td>239.4</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>189.66</td>
<td>70.72</td>
<td>199.5</td>
</tr>
<tr>
<td>Overhead press</td>
<td>pretest</td>
<td>89.78</td>
<td>52.43</td>
<td>178.2</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>139.83</td>
<td>60.94</td>
<td>195.9</td>
</tr>
<tr>
<td>Biceps curl</td>
<td>pretest</td>
<td>69.43</td>
<td>34.42</td>
<td>138.3</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>95.00</td>
<td>39.52</td>
<td>175.6</td>
</tr>
<tr>
<td>Seated dip</td>
<td>pretest</td>
<td>133.40</td>
<td>80.46</td>
<td>280.0</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>187.18</td>
<td>80.31</td>
<td>242.1</td>
</tr>
<tr>
<td>Lower back</td>
<td>pretest</td>
<td>97.49</td>
<td>49.21</td>
<td>146.3</td>
</tr>
<tr>
<td></td>
<td>posttest</td>
<td>135.84</td>
<td>48.82</td>
<td>133.0</td>
</tr>
</tbody>
</table>

All means increased significantly (P < .001).

Figure 1 — Average predicted 1RM over the 3-month training period for all participants.

*P < .001.

In addition, the data indicate that the males were proportionally stronger than the females for 5 of the 7 exercises: the chest press (F_{1,28} = 4.656, P = .04), seated row (F_{1,28} = 4.900, P = .035), overhead press (F_{1,28} = 4.806, P = .037), seated dip (F_{1,28} = 5.353, P = .028), and biceps curl (F_{1,28} = 3.212, P = .084). See Figure 2.

A significant interaction was demonstrated, however, for the seated-dip exercise (F_{1,28} = 4.799, P = .037); this interaction indicates a disproportionately higher increase in strength for males on this exercise. See Figure 3.
Exercise training has demonstrated important implications for people with ID. Although it seems that current data indicate that individuals with ID have low levels of physical fitness and body-mass index that are considered unhealthy or obese, they might be able to respond to exercise training similarly to how those without disabilities would respond. A positive correlation has been found between muscle strength and ability level or work productivity. Researchers have directly related physical fitness levels to work productivity among individuals with ID in various studies. It has been stated that “competence in upper body muscular skills are a prerequisite for many vocational/job opportunities, and body strength is valuable for recreation and activities of daily living.” This demonstrates a
direct need for our research, as well as the importance for individuals with ID to engage in resistance training. It not only affords the participants the necessary muscular abilities to stock shelves and carry boxes in the workplace but also helps with their career transition and improves their overall quality of life. It was with this intention that our program was founded in 1987 and still runs today. Over the past 2 decades participants in the resistance-training program for individuals with ID have not suffered from any major physical limitation in the workplace.

We found males to be stronger than females for 5 of the 7 exercises studied. Although both males and females experienced similar gains in weight lifted, the males were able to lift more weight. This result indicates that males were the stronger subjects. This is not a fair comparison of muscle strength, however, because males on average weigh more than females. Women also have a higher percentage of body fat than men do. So pound-for-pound muscle strength for males and females is about even. As a matter of fact Westcott and Winett\textsuperscript{36} found that women respond to strength exercise at the same rate as men do. This indicates that on a muscle-to-muscle basis women are just as strong as men.

Group means showed a significant increase for all exercises in the test battery. It was curious that the males exhibited a larger average weight increase for only 1 exercise, the seated dip. Perhaps this was because of the greater number of muscle groups trained by the exercise, coupled with the larger muscle mass commonly observed in males. Although a relatively large variation in pretraining and post-training weight lifted was displayed, the males and females exhibited similar and significant increases in weight lifted. So, regardless of the relatively high variances in the weight lifted, the average increases for the group were greater than these standard deviations.

After beginning the resistance training, SO athletes can excel or be held back, depending on the staff person who is guiding them, so sufficient staff training and supervision are essential.\textsuperscript{3} The order of exercise completion is a key factor for performance. In this study, the sequence in which the exercises were completed was based on availability of the equipment; therefore, there was no set routine as to which exercise would be performed first or last. Although the ideal order for lifting would go from larger muscle groups (such as the lower extremity) to smaller ones, significant improvements on all exercises were still seen. This is important to note because it invites the participation of more people to more programs, despite the fact that less than ideal conditions might be available.

Regarding participant motivation, these SO athletes were highly motivated. Their good behavior at school was rewarded with a twice-weekly visit to campus to participate in the supervised resistance-training program with a university partner of similar age. The teachers of the SO athletes often commented that for many of these youth, this program was the only motivation for them to come to school.

As Pitetti and Campbell\textsuperscript{33} declared in their 1991 study, this is indeed a population at risk. All persons, regardless of their limitations, have a right to a lifestyle of health and physical fitness. Individuals with disabilities, however, especially cognitive disabilities, often find less opportunity to participate in such fitness, wellness, and recreational programs.\textsuperscript{3,36–38} Arguably, though, these individuals benefit from and need such programs as much as, if not more than, their nondisabled peers.
Conclusion

Significant strength gains can be realized by adolescents and young adults with moderate to severe ID by participating twice weekly in a resistance-training program. It appears that this population, including males and females with ID, experience strength gains similar to those of their peers without disabilities when given a supervised training program. These individuals not only become stronger and more confident in the gym but also have an increased motivation in school, they live healthier lifestyles, and their transition into the workplace is easier and less risky as a result of their improved muscle fitness.

Acknowledgments

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References